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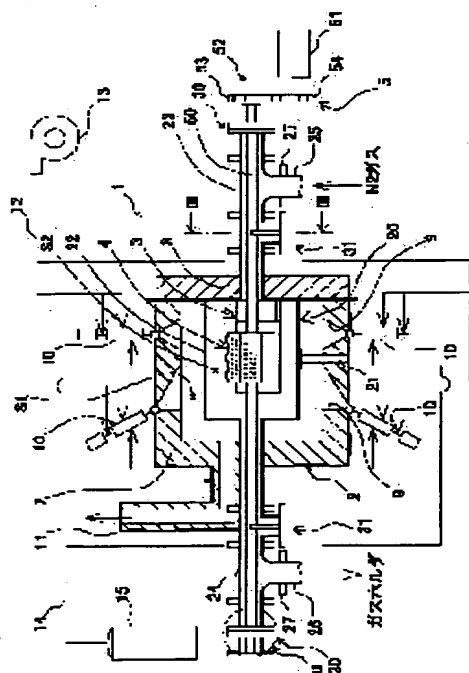
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## (54) CARBON PRODUCTION DEVICE



### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a small, simple carbon production device which can produce activated carbon having a large specific surface area from waste tires as a raw material and can easily be maintained.

**SOLUTION:** This carbon production device 1 is provided with a heating oven 2 into which a hot gas is charged, a bucket 3 and a chip holder 4 disposed in the heating oven 2, and a holder-rotating means 5 for rotating the chip holder 4. When the holder 4 is rotated with the holder-rotating means 5 in the device carbon production 1, waste tire chips T received in the chip holder 4 is mixed with potassium hydroxide supplied into the bucket 3 to give the high quality activated carbon.

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**CLAIMS**

[Claim(s)]

[Claim 1] The heating furnace with which hot blast is sent into the interior, and the container with which it is prepared in this heating furnace, and hydroxylation alkali metal is supplied, The at least 1 section is contained in this container, and it has the chip holder which can hold the chip which comes to grind a waste tire, and a holder rotation means to rotate this chip holder. Said chip holder It has the through tube which can regulate passage of said chip. With said holder rotation means The charcoal manufacturing installation characterized by rotating said chip holder, heating, contacting said chip in this chip holder, and said hydroxylation alkali metal with which melting of [ in said container ] was carried out through said through tube, and obtaining carbide.

[Claim 2] Said holder rotation means is a charcoal manufacturing installation [ equipped with the coordinated device which coordinates a driving source, the holder shaft which is attached in said chip holder and supported free / rotation / to said heating furnace, and this driving source and this holder shaft ] according to claim 1.

[Claim 3] Said heating furnace is a charcoal manufacturing installation [ equipped with the tubed furnace body which carried out opening of the end side and turned the axial center horizontally, and the lid with which this furnace body is equipped free / attachment and detachment / and which closes opening of this furnace body ] according to claim 1 or 2.

[Claim 4] Said heating furnace is a charcoal manufacturing installation according to claim 3 which divides the building envelope of this heating furnace to two, and is equipped with the seating-rim object with which inert gas is sent into the interior and by which said bucket and said chip holder are formed in this seating-rim inside of the body.

[Claim 5] Said chip holder is a charcoal manufacturing installation given in claim 1 which is an rectangular pipe-like thru/or any 1 term of 4.

[Claim 6] a charcoal manufacturing installation given in claim 1 equipped with the closing motion covering device material which can open and close opening and this opening for said chip holder to carry out feeding-and-discarding appearance of said chip thru/or any 1 term of 5.

[Claim 7] The heating furnace with which hot blast is sent into the interior, and the container with which it is prepared in this heating furnace, and hydroxylation alkali metal is supplied, The at least 1 section is contained in this container, and it has the chip holder which can hold the chip which comes to grind a waste tire, and a holder rotation means to rotate this chip holder. Said heating furnace The tubed furnace body which carried out opening of the end side and turned the axial center horizontally, and the lid with which this furnace body is equipped free [ attachment and detachment ] and which closes opening of this furnace body, The building envelope of this heating furnace is divided to two, and it has the seating-rim object with which

nitrogen gas is sent into the interior. This seating-rim object It has the supply pipe and exhaust pipe for nitrogen gas which are prolonged along with the axial center of said furnace body, one tubing is formed in said furnace body among this supply pipe and an exhaust pipe, and tubing of another side is formed in said lid. Said holder rotation means A driving source, It is attached in said chip holder and has the coordinated device which coordinates the holder shaft prolonged along with the axial center of said furnace body, and this driving source and this holder shaft. This holder shaft It is supported free [ rotation ] on the same axle inside said supply pipe of said seating-rim object, and an exhaust pipe. Said chip holder It has the through tube which can regulate passage of said chip while attaching two or more plates and being formed in the shape of an rectangular pipe. With said holder rotation means The charcoal manufacturing installation characterized by rotating said chip holder, heating them, contacting said chip in this chip holder, and said hydroxylation alkali metal with which melting of [ in said container ] was carried out through said through tube under nitrogen-gas-atmosphere mind, and obtaining carbide.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention can obtain activated carbon with a big specific surface area by using a waste tire as a raw material in more detail about a charcoal manufacturing installation, and relates to the small and simple charcoal manufacturing installation excellent in maintenance nature.

[0002]

[Description of the Prior Art] Since there is a property to adsorb the matter, activated carbon is widely used as a deodorant, a purification agent of a solution, etc. And conventionally, activated carbon is manufactured considering fruits husks or coal, such as a carbonaceous ingredient, for example, wood, and coconut husks, etc. as a raw material.

[0003] Moreover, the yield of a waste tire is increasing rapidly with the spread of automobiles in recent years, and since it is moreover becoming difficult from problems, such as a throughput of a disposal field, to only carry out disposal of the all, the effective reuse approach of a waste tire is examined. The technique of manufacturing the activated carbon which used the waste tire as the raw material from this viewpoint is proposed (JP,9-227112,A, JP,4-292409,A, etc.).

[0004] for example, to JP,9-227112,A By sending hot blast into the interior, while having the tubed furnace body which comes to prepare a whorl protruding line in an inner skin side and rotating this furnace body The charcoal manufacturing installation of the rotary kiln type which heats conveying it toward the other end from the end of a furnace body while stirring the chip which comes to grind the ashes tire supplied from an end side in this furnace body by the whorl protruding line, and manufactures activated carbon is indicated. However, in the charcoal manufacturing installation of the above-mentioned rotary kiln type, by long-term use of this equipment, carbide tended to adhere to the spiral protruding line of the inner skin of a furnace body, and the maintenance of cleaning of furnace body inner skin etc. needed to be performed frequently. Moreover, in case a maintenance was carried out, many components concerning a furnace body etc. had to be demounted and it was a complicated activity. Moreover, since it was what rotates a furnace body with comparatively big weight, it became complicated as the whole equipment, and large-sized. Furthermore, since the charcoal manufacturing installation of the above-mentioned rotary kiln type is the so-called steam activation method, its specific surface area of the activated carbon obtained is comparatively small.

[0005] Moreover, for example, according to JP,4-292409,A, the technique of manufacturing activated carbon by chip-izing a waste tire, mixing this and alkali-metal salts, such as a potassium hydroxide, and heating at 600-700 degrees C is indicated, but In this case, the specific surface area of the activated carbon obtained had stopped at the level of 450m<sup>2</sup>/g, and

was not what can attain a target specific surface area (preferably more than 800m<sup>2</sup>/g more preferably more than 1000m<sup>2</sup>/g).

[0006]

[Problem(s) to be Solved by the Invention] As mentioned above, this invention is made in view of the above-mentioned actual condition, by using a waste tire as a raw material, can obtain activated carbon with a big specific surface area, and aims at offering the small and simple charcoal manufacturing installation excellent in maintenance nature.

[0007]

[Means for Solving the Problem] The container with which the charcoal manufacturing installation of this invention is prepared in the heating furnace with which hot blast is sent into the interior, and this heating furnace, and hydroxylation alkali metal is supplied, The at least 1 section is contained in this container, and it has the chip holder which can hold the chip which comes to grind a waste tire, and a holder rotation means to rotate this chip holder. Said chip holder It has the through tube which can regulate passage of said chip. With said holder rotation means It is characterized by rotating said chip holder, heating, contacting said chip in this chip holder, and said hydroxylation alkali metal with which melting of [ in said container ] was carried out through said through tube, and obtaining carbide.

[0008] According to the charcoal manufacturing installation of this invention, the chip which could heat, contacting the chip and hydroxylation alkali metal which come to grind a waste tire in a heating furnace, and was contained by rotation of a chip holder can be stirred, and hydroxylation alkali metal can fully be mixed. Therefore, activated carbon with a big specific surface area can be obtained. Furthermore, compared with the charcoal manufacturing installation of the conventional rotary kiln type, it excels in maintenance nature and can consider as small and simple structure.

[0009] Moreover, said holder rotation means is attached in said chip holder with a driving source, and can be equipped with the coordinated device which coordinates the holder shaft supported free [ rotation ] to said heating furnace, and this driving source and this holder shaft. Thereby, a chip holder can be rotated easily and correctly.

[0010] Moreover, said heating furnace can carry out opening of the end side, and can be equipped with the tubed furnace body which turned the axial center horizontally, and the lid with which this furnace body is equipped free [ attachment and detachment ] and which closes opening of this furnace body. Thereby, maintenance nature, such as cleaning inside a furnace body, can be raised more, and feeding-and-discarding appearance of the chip to a chip holder can be carried out easily.

[0011] Moreover, said heating furnace divides the building envelope of this heating furnace to two, and is equipped with the seating-rim object with which inert gas is sent into the interior, and said bucket and said chip holder can be formed in this seating-rim inside of the body. Thereby, a chip and hydroxylation alkali metal can be contacted under the ambient atmosphere of inert gas, and the specific surface area of the activator obtained can be raised more.

[0012] Moreover, said chip holder can be an rectangular pipe-like. Thereby, a chip and hydroxylation alkali metal are efficiently mixable.

[0013] moreover, said chip holder can be equipped with the closing motion covering device material which can open and close opening and this opening for carrying out feeding-and-discarding appearance of said chip. Thereby, feeding-and-discarding appearance of the chip to a chip holder can be performed efficiently.

[0014] Moreover, the heating furnace with which, as for the charcoal manufacturing installation

of other this inventions, hot blast is sent into the interior, The chip holder which can hold the chip which it is prepared in this heating furnace, and the at least 1 section is contained in the container with which hydroxylation alkali metal is supplied, and this container, and comes to grind a waste tire, It has a holder rotation means to rotate this chip holder. Said heating furnace The tubed furnace body which carried out opening of the end side and turned the axial center horizontally, and the lid with which this furnace body is equipped free [ attachment and detachment ] and which closes opening of this furnace body, The building envelope of this heating furnace is divided to two, and it has the seating-rim object with which nitrogen gas is sent into the interior. This seating-rim object It has the supply pipe and exhaust pipe for nitrogen gas which are prolonged along with the axial center of said furnace body, one tubing is formed in said furnace body among this supply pipe and an exhaust pipe, and tubing of another side is formed in said lid. Said holder rotation means A driving source, It is attached in said chip holder and has the coordinated device which coordinates the holder shaft prolonged along with the axial center of said furnace body, and this driving source and this holder shaft. This holder shaft It is supported free [ rotation ] on the same axle inside said supply pipe of said seating-rim object, and an exhaust pipe. Said chip holder It has the through tube which can regulate passage of said chip while attaching two or more plates and being formed in the shape of an rectangular pipe. With said holder rotation means It is characterized by rotating said chip holder, heating them, contacting said chip in this chip holder, and said hydroxylation alkali metal with which melting of [ in said container ] was carried out through said through tube under nitrogen-gas-atmosphere mind, and obtaining carbide.

[0015] In addition, while being able to prevent that the carbide which can perform the heating process of a chip easily and is obtained adheres to instruments, such as a chip holder, as the above "hydroxylation alkali metal" if a potassium hydroxide is used as the below-mentioned example shows especially although the mixture of potassium-hydroxide independence, a sodium-hydroxide independent, and both can be mentioned, since specific surface area of the activated carbon obtained can be enlarged more, it is desirable. Moreover, nitrogen, an argon, helium, etc. can be mentioned as the above "inert gas." It is desirable that it is Hastelloy which is excellent in corrosion resistance, for example as the quality of the material of the above "a holder shaft" and a "chip holder."

[0016]

[Embodiment of the Invention] Hereafter, an example explains this invention concretely using a drawing. In addition, in the charcoal manufacturing installation 1 (refer to drawing 1 ) of this example, the chip T (refer to drawing 5 ) which comes to grind a waste tire as a raw material is used. Although considered as the carbide already carbonized at the carbonization furnace about the waste tire, you may be a raw thing before carbonization. Moreover, as long as it can grind about the grinding approach, there is especially no limitation and a well-known grinder can grind it. Moreover, in consideration of the terms and conditions of a facility etc., it can consider as various magnitude also with the size of Chip T, and is usually 3-5mm angle extent. Furthermore, when this metal remained, and it heated with the potassium hydroxide mentioned later, hydrogen gas was generated in large quantities, and although metals, such as a wire, were usually contained in the tire, since it was dangerous, desteel processing should be performed using the well-known magnetic separator.

[0017] 1. As shown in the block diagram 1 of a charcoal manufacturing installation, the charcoal manufacturing installation 1 is equipped with a heating furnace 2, the bucket 3 (it illustrates as a container.) and the chip holder 4 which are arranged in this heating furnace 2, and a holder

rotation means 5 to rotate this chip holder 4, and is constituted.

[0018] First, the above-mentioned heating furnace 2 is equipped with the cylinder-like furnace body 7 to which opening of the end side was carried out, and the axial center was turned horizontally. This furnace body 7 is equipped with the disc-like lid 8 which closes this opening to an end opening side free [ attachment and detachment ] by fixed means, such as a screw. Moreover, a phase is shifted at the predetermined spacing and the supply way 9 of plurality (four) is formed in the circumferencial direction and the direction of an axial center of the furnace body 7 at the periphery side of the furnace body 7. These supply way 9 is equipped with a gas burner 10, and hot blast is sent into the building envelope of a heating furnace 2 with this gas burner 10. Moreover, the chimney stack 11 of the plurality (2) for missing exhaust gas to the other end side of the furnace body 7 is formed in one. In addition, the gas burner 10 of the above-mentioned plurality (four) is connected to the propane chemical cylinder 15 through gas piping 14 while connecting with a blower 13 through pneumatic piping 12.

[0019] The above-mentioned heating furnace 2 is equipped with the seating-rim object 20 which divides a building envelope to two space S1 and S2 in outside. This seating-rim object 20 has the cylindrical frame part 22 which serves as a minor diameter from the diameter of inner circumference of the furnace body 7 through the supporter material 21, and the supply pipe 23 and exhaust pipe 24 which stand in a row in the building envelope of this cylindrical frame part 22. The supply pipe 23 was attached in the abbreviation center section of said lid 8 at one, and is horizontally prolonged toward the way outside the heating furnace 2. In the middle of this supply pipe 23, rectangular connection of the interconnecting tube 25 for supplying nitrogen gas is carried out. Moreover, the exhaust pipe 24 was formed in the end side of the cylindrical frame part 22 at one, ran through the other end side of the furnace body 7, and is horizontally prolonged toward the method of the outside of a heating furnace 2. In the middle of this exhaust pipe 24, rectangular connection of the interconnecting tube 26 for missing nitrogen gas to a gas holder (not shown) is carried out. In addition, each above-mentioned interconnecting tubes 25 and 26 are attached free [ attachment and detachment ] by fixed means, such as a screw, through the flange 27 to the supply pipe 23 and the exhaust pipe 24.

[0020] Moreover, in the middle of the above-mentioned supply pipe 23 and the exhaust pipe 24, the bearing section 30 and bearing 31 for support of the holder shaft mentioned later are arranged, respectively. In the bearing section 30, as shown in drawing 2, bearing 33 is built in in the bearing case 32 attached in the exhaust pipe 24 (supply pipe 23) by welding etc., and the holder shaft 50 is supported by this bearing 33 free [ rotation ]. Moreover, in the bearing section 30 by the side of an exhaust pipe 24, bearing 33 and the holder shaft 50 are not made into one, therefore horizontal migration of the holder shaft 50 is made free along with the axial center in the exhaust pipe 24 interior. Moreover, in the above-mentioned bearing 31, as shown in drawing 3, the tabular supporter material 36 is fixed to a supply pipe 23 (exhaust pipe 24) through a flange 35, and the holder shaft 50 is supported by the notch 39 of the shape of a semicircle of this supporter material 36. Therefore, the deflection of the holder shaft 50 is prevented.

[0021] Next, the above-mentioned bucket 3 is formed in the configuration where the axial center was turned horizontally and where it was cylindrical, and cut the periphery bottom and the upper part was opened wide as shown in drawing 4 and 5. Moreover, a dashboard 41 is fixed in a bucket 3 and the building envelope of a bucket 3 is divided into the space to which the potassium hydroxide mentioned later is supplied, and the space for attaching a bucket 3 in a lid 8 by this dashboard 41. And it is fixed to the rear-face side of a lid 8 free [ attachment and detachment ] by fixed means, such as a screw, and the bucket 3 is located in the cylindrical



frame part 22 with the chip holder 4 mentioned later.

[0022] Next, as shown in drawing 4 and 5, the above-mentioned chip holder 4 attaches two or more plates 44 (for example, punching metal etc.) which form uniformly round hole-like many through tubes 43 in the whole surface, and become by welding etc., and is formed in the shape of [ which turned the axial center horizontally ] 6 rectangular pipes. Most except the upper limit section of this chip holder 4 is contained in the building envelope of the above-mentioned bucket 3. Moreover, it is equipped with one plate 44a (it illustrates as closing motion covering device material.) which constitutes the peripheral face of the chip holder 4 free [ closing motion ] through the hinge 45 and the fastener 46. Therefore, when this plate 44a is opened wide, opening 47 can be formed in the peripheral face of the chip holder 4, and injection supply of the chip T can be carried out into the chip holder 4 through this opening 47. Moreover, a mounting hole 48 is formed in the both-ends side side of the chip holder 4, and the holder shaft 50 is attached by welding etc. in the shape of food on a skewer through these mounting holes 48. In addition, it is set as the magnitude of extent which can regulate passage (fall) of the chip T supplied as magnitude of the above-mentioned through tube 43, and when the magnitude of Chip T is 3-5mm, the diameter of a through tube 43 is usually set as about 2mm.

[0023] Next, it returns to drawing 1 again and the above-mentioned holder rotation means 5 is explained. This holder rotation means 5 is equipped with the gear device 52 (it illustrates as a coordinated device.) which coordinates the above-mentioned holder shaft 50 and a drive motor 51 (it illustrates as a driving source.). The above-mentioned holder shaft 50 is supported by the bearing section 30 and bearing 31 free [ rotation ] as mentioned above inside said cylindrical frame part 22, the supply pipe 23, and the exhaust pipe 24. Moreover, the above-mentioned gear device 52 consists of a gear 53 fixed to the end side of this holder shaft 50, and a gear 54 fixed to the output shaft of the drive motor 51 which gears with this gear 53. And the driving force of a drive motor 51 is transmitted to the holder shaft 50 through the gear device 52, and the chip holder 4 rotates with a predetermined rotational speed with this holder shaft 50.

[0024] 2. Explain an operation of a charcoal manufacturing installation, next the operation of the charcoal manufacturing installation 1 constituted as mentioned above. First, plate 44a is wide opened to the chip holder 4, the chip T of the specified quantity (about 1kg) is supplied from opening 47, and the potassium hydroxide of the flake-like specified quantity (about 4kg) is supplied to the space in a bucket 3 (refer to drawing 5). In this condition, as shown in drawing 1, aeration of the nitrogen gas is carried out into the cylindrical frame part 22 through a supply pipe 23, and this nitrogen gas is exhausted to a gas holder through an exhaust pipe 24. And air and gas are supplied to each gas burner 10, and a heating furnace 2 is heated. With this heating, the space S2 in a heating furnace 2, i.e., the temperature in the cylindrical frame part 22, goes up from ordinary temperature to about 880 degrees C (business time amount 50 minutes), and suppose it that about 880 degrees C is held after that for 100 minutes. Moreover, the temperature of the space S1 in a heating furnace 2 rises to about 900-950 degrees C, and 800-850-degree C exhaust gas is further exhausted from a chimney stack 11.

[0025] During the above-mentioned heating, a drive motor 51 is operated and the chip holder 4 is rotated with the speed of about 1 rotation per minute with the holder shaft 50. Then, contacting the potassium hydroxide with which melting of the chip T stirred within the chip holder 4 was carried out through many through tubes 43, it will be heated under nitrogen-gas-atmosphere mind, and the activated carbon of high quality will be manufactured.

[0026] Then, after the above-mentioned heating is completed, immobilization with the furnace body 7 and a lid 8 is canceled, the cooperation with a drive motor 51 and the holder shaft 50 is

canceled, and connection to the supply pipe 23 and exhaust pipe 24 of each interconnecting tubes 25 and 26 is canceled further. When the horizontal migration of the lid 8 is made to carry out in the estrangement direction to the furnace body 7 in this condition, the bucket 3 of a lid 8 and one, a supply pipe 23, and the chip holder 4 will be taken out from the inside of the furnace body 7, and the obtained activated carbon will be collected.

[0027] 3. the effectiveness of an example -- as mentioned above, by this example, since it was made to make it heat under nitrogen-gas-atmosphere mind, contacting the chip T which a drive motor 51 is operated, is made to rotate the chip holder 4 with the speed of about 1 rotation per minute with the holder shaft 50, and is stirred within the chip holder 4 to the potassium hydroxide by which melting was carried out, activated carbon with a big (more than 1000m<sup>2</sup>/g) specific surface area can be obtained by corrosive [ of a potassium hydroxide ]. Moreover, in this example, since the chip holder 4 is formed in the shape of [ which comes to attach two or more plates 44 / simple ] 6 rectangular pipes, it can stir the chip T in the chip holder 4 easily, can fully mix Chip T and a potassium hydroxide, and can obtain more nearly quality activated carbon. Furthermore, carbide cannot adhere easily in the chip holder 4, and the count of a maintenance, such as cleaning of this chip holder 4, can be reduced.

[0028] Moreover, in this example, since it enabled it to take out a bucket 3 and the chip holder 4 with a lid 8 to the furnace body 7, a maintenance of the furnace body 7 interior and each part article can be performed easily and quickly. Moreover, since only the chip holder 4 is rotated and it was made to stir Chip T, compared with what rotates a furnace body with comparatively big weight like the charcoal manufacturing installation of the conventional rotary kiln type, it can consider as simple structure small as the whole equipment and. Moreover, in this example, since the holder shaft 50 was supported free [ rotation ] by the bearing section 30 and bearing 31 of a pair, even if it can prevent the deflection of the holder shaft 50 etc. and uses this equipment over a long period of time, the chip holder 4 can be rotated correctly.

[0029] In addition, in this invention, it is not restricted to what is shown in said concrete example, but can consider as the example variously changed within the limits of this invention according to the purpose and the application. That is, in this example, although the chip holder 4 was formed in the shape of 6 rectangular pipes, it is not limited to this, but it can consider as the less than six shape of 4 and 5 rectangular pipes etc., or can consider as the shape of 7 and 8 rectangular pipes etc. exceeding 6, and can form in the shape of a cylinder further. Moreover, although round hole-like many through tubes 43 were formed in the peripheral surface and the chip holder 4 was constituted from this example in it, it is not limited to this, for example, two or more long hole-like through tubes can be installed in the peripheral surface for a chip holder side by side, and it can constitute, or the unit or two or more through tubes of the shape of a curled form or bellows can be prepared and constituted. Moreover, although the hot blast by the gas burner 10 was exhausted in atmospheric air through the chimney stack 11, it is not limited to this but you may make it use exhaust gas for heating of a heating furnace again in this example.

[0030]

[Effect of the Invention] According to the charcoal manufacturing installation of this invention, a chip and hydroxylation alkali metal can fully be mixed in a heating furnace, and activated carbon with a big specific surface area can be obtained. Furthermore, the charcoal manufacturing installation of small and simple structure excellent in maintenance nature can be offered.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] It is a schematic diagram for explaining the charcoal manufacturing installation concerning an example.

[Drawing 2] It is the expanded sectional view of II view section of drawing 1 .

[Drawing 3] It is the III-III line expanded sectional view of drawing 1 .

[Drawing 4] It is the important section expanded sectional view of drawing 1 .

[Drawing 5] It is the V-V line sectional view of drawing 4 .

[Description of Notations]

1; charcoal manufacturing installation, 2; heating furnace, 3; bucket, 4; chip holder, 5; holder rotation means, 7; furnace body, 8; lid, 20; seating-rim object, 43; through tube, a 44a; plate, 47; opening, 50; holder shaft, 51; drive motor, 52; gear device, T; chip.

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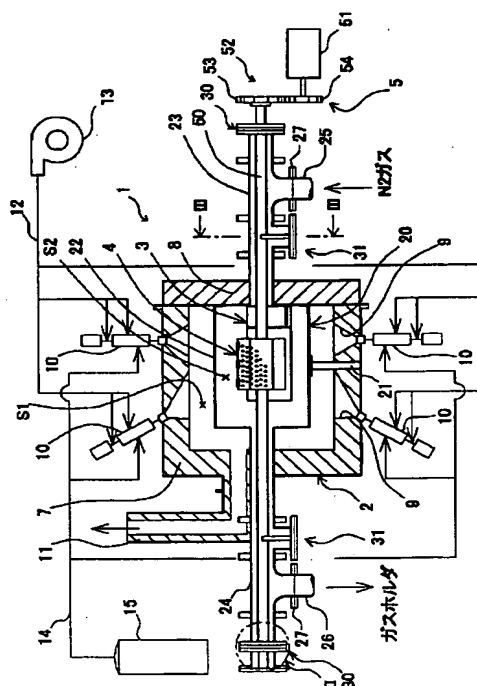
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(54) 【発明の名称】 炭製造装置

(57) 【要約】

【課題】 廃タイヤを原料として、比表面積の大きな活性炭を製造することができ、さらにメンテナンス性に優れた小型・簡易な炭製造装置を提供する。

【解決手段】 本装置1は、内部に熱風が送り込まれる加熱炉2と、この加熱炉2内に設けられるバケット3及びチップホルダ4と、このチップホルダ4を回転させるホルダ回転手段5とを備えて構成される。本装置1によると、ホルダ回転手段5によってチップホルダ4が回転され、このチップホルダ4内に収容される廃タイヤチップTと、バケット3内に供給される水酸化カリウムとが混ぜ合わさり、高品質な活性炭が得られる。



## 【特許請求の範囲】

【請求項1】 内部に熱風が送り込まれる加熱炉と、該加熱炉内に設けられ、水酸化アルカリ金属が供給される容器と、該容器内に少なくとも1部が収納され、廃タイヤを粉砕してなるチップを収容可能なチップホルダと、該チップホルダを回転させるホルダ回転手段とを備え、前記チップホルダは、前記チップの通過を規制し得る貫通孔を有し、前記ホルダ回転手段によって、前記チップホルダを回転させて、該チップホルダ内の前記チップと、前記容器内の溶融された前記水酸化アルカリ金属とを前記貫通孔を介して接触させつつ加熱して炭化物を得ることを特徴とする炭製造装置。

【請求項2】 前記ホルダ回転手段は、駆動源と、前記チップホルダに取着され、前記加熱炉に対して回転自在に支持されるホルダ軸と、該駆動源と該ホルダ軸とを連繋する連繋機構とを備える請求項1記載の炭製造装置。

【請求項3】 前記加熱炉は、一端側を開口し、軸心を水平に向けた筒状の炉本体と、該炉本体に着脱自在に装着され該炉本体の開口を閉鎖する蓋体とを備える請求項1又は2記載の炭製造装置。

【請求項4】 前記加熱炉は、該加熱炉の内部空間を2つに区画し、内部に不活性ガスが送り込まれる内枠体を備え、前記バケット及び前記チップホルダが該内枠体内に設けられる請求項3記載の炭製造装置。

【請求項5】 前記チップホルダは角筒状である請求項1乃至4のいずれか一項に記載の炭製造装置。

【請求項6】 前記チップホルダは、前記チップを給排出するための開口部と、該開口部を開閉可能な開閉蓋部材とを備える請求項1乃至5のいずれか一項に記載の炭製造装置。

【請求項7】 内部に熱風が送り込まれる加熱炉と、該加熱炉内に設けられ、水酸化アルカリ金属が供給される容器と、該容器内に少なくとも1部が収納され、廃タイヤを粉砕してなるチップを収容可能なチップホルダと、該チップホルダを回転させるホルダ回転手段とを備え、前記加熱炉は、一端側を開口し、軸心を水平に向けた筒状の炉本体と、該炉本体に着脱自在に装着され該炉本体の開口を閉鎖する蓋体と、該加熱炉の内部空間を2つに区画し、内部に窒素ガスが送り込まれる内枠体とを備え、該内枠体は、前記炉本体の軸心に沿って延びる窒素ガス用の供給管及び排出管を有し、該供給管及び排出管のうち一方の管が前記炉本体に設けられ、他方の管が前記蓋体に設けられ、

前記ホルダ回転手段は、駆動源と、前記チップホルダに取着され、前記炉本体の軸心に沿って延びるホルダ軸と、該駆動源と該ホルダ軸とを連繋する連繋機構とを備え、該ホルダ軸は、前記内枠体の前記供給管及び排出管の内部に同軸上で回転自在に支持され、

前記チップホルダは、複数の板材を組付けて角筒状に形成されると共に前記チップの通過を規制し得る貫通孔を

有し、前記ホルダ回転手段によって、前記チップホルダを回転させて、該チップホルダ内の前記チップと、前記容器内の溶融された前記水酸化アルカリ金属とを、窒素雰囲気下で前記貫通孔を介して接触させつつ加熱して炭化物を得ることを特徴とする炭製造装置。

## 【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は炭製造装置に関し、更に詳しくは、廃タイヤを原料として、比表面積が大きな活性炭を得ることができ、メンテナンス性に優れた小型・簡易な炭製造装置に関する。

【0002】

【従来の技術】活性炭は物質を吸着する性質があることから、脱臭剤、溶液の精製剤等として広く使用されている。そして従来より、活性炭は、炭素質材料、例えば木材や椰子殻等の果実殻あるいは石炭等を原料として製造されている。

【0003】また、近年は自動車の普及にともなって廃タイヤの発生量が急増しており、しかも、処分場の処理能力等の問題から、その全てを単に廃棄処分することが困難となりつつあることから、廃タイヤの有効な再利用方法が検討されている。かかる観点から、廃タイヤを原料とした活性炭を製造する技術が提案されている（特開平9-227112号公報、特開平4-292409号公報等）。

【0004】例えば、特開平9-227112号公報には、内周面側にらせん突条を設けてなる筒状の炉本体を備え、この炉本体を回転させると共に内部に熱風を送り込むことによって、この炉本体内に一端側から投入される灰タイヤを粉砕してなるチップを、らせん突条により攪拌すると共に炉本体の一端から他端に向かって搬送しつつ加熱して活性炭を製造するロータリーキルン式の炭製造装置が開示されている。しかし、上記ロータリーキルン式の炭製造装置では、この装置の長期使用によって、炉本体の内周面のらせん状突条に炭化物が付着し易く、炉本体内周面の清掃等のメンテナンス作業を頻繁に行う必要があった。また、メンテナンス作業を実施する際には、炉本体等に係わる多くの部品を取外さなければならず煩雑な作業であった。また、比較的重量の大きな炉本体を回転させるものであるため、装置全体として複雑で大型なものとなっていた。さらに、上記ロータリーキルン式の炭製造装置は、いわゆる水蒸気賦活法であるため、得られる活性炭の比表面積が比較的小さなものである。

【0005】また、例えば、特開平4-292409号公報によれば、廃タイヤをチップ化し、これと水酸化カリウム等のアルカリ金属塩とを混合して600～700℃で加熱することにより活性炭を製造する技術が記載されているが、この場合、得られる活性炭の比表面積は450m<sup>2</sup>/gのレベルに留まっており、目標とする比表

面積（好ましくは $800\text{m}^2/\text{g}$ 以上、より好ましくは $1000\text{m}^2/\text{g}$ 以上）を達成し得るものではなかった。

【0006】

【発明が解決しようとする課題】以上より、本発明は、上記実情に鑑みてなされたものであり、廃タイヤを原料として、比表面積が大きな活性炭を得ることができ、メンテナンス性に優れた小型・簡易な炭製造装置を提供することを目的とする。

【0007】

【課題を解決するための手段】本発明の炭製造装置は、内部に熱風が送り込まれる加熱炉と、該加熱炉内に設けられ、水酸化アルカリ金属が供給される容器と、該容器内に少なくとも1部が収納され、廃タイヤを粉碎してなるチップを収容可能なチップホルダと、該チップホルダを回転させるホルダ回転手段とを備え、前記チップホルダは、前記チップの通過を規制し得る貫通孔を有し、前記ホルダ回転手段によって、前記チップホルダを回転させて、該チップホルダ内の前記チップと、前記容器内の溶融された前記水酸化アルカリ金属とを前記貫通孔を介して接触させつつ加熱して炭化物を得ることを特徴とする。

【0008】本発明の炭製造装置によると、加熱炉内において、廃タイヤを粉碎してなるチップと水酸化アルカリ金属とを接触させつつ加熱することができ、また、チップホルダの回転により収納されたチップを攪拌して水酸化アルカリ金属と十分に混ぜ合わせることができる。従って、比表面積の大きな活性炭を得ることができる。さらに、従来のロータリーキルン式の炭製造装置に比べて、メンテナンス性に優れ、かつ小型で簡易な構造とすることができる。

【0009】また、前記ホルダ回転手段は、駆動源と、前記チップホルダに取着され、前記加熱炉に対して回転自在に支持されるホルダ軸と、該駆動源と該ホルダ軸とを連繋する連繋機構とを備えることができる。これにより、チップホルダを容易かつ正確に回転させることができる。

【0010】また、前記加熱炉は、一端側を開口し、軸心を水平に向けた筒状の炉本体と、該炉本体に着脱自在に装着され該炉本体の開口を閉鎖する蓋体とを備えることができる。これにより、炉本体内部の清掃作業等のメンテナンス性をより向上させることができ、また、チップホルダへのチップの給排出を容易に実施することができる。

【0011】また、前記加熱炉は、該加熱炉の内部空間を2つに区画し、内部に不活性ガスが送り込まれる内枠体を備え、前記バケット及び前記チップホルダは該内枠体内に設けられることができる。これにより、チップと水酸化アルカリ金属とを不活性ガスの雰囲気下で接触させることができ、得られる活性体の比表面積をより向上

させることができる。

【0012】また、前記チップホルダは角筒状であることができる。これにより、チップと水酸化アルカリ金属とを効率よく混合することができる。

【0013】また、前記チップホルダは、前記チップを給排出するための開口部と、該開口部を開閉可能な開閉蓋部材とを備えることができる。これにより、チップホルダへのチップの給排出を効率よく行うことができる。

【0014】また、他の本発明の炭製造装置は、内部に熱風が送り込まれる加熱炉と、該加熱炉内に設けられ、水酸化アルカリ金属が供給される容器と、該容器内に少なくとも1部が収納され、廃タイヤを粉碎してなるチップを収容可能なチップホルダと、該チップホルダを回転させるホルダ回転手段とを備え、前記加熱炉は、一端側を開口し、軸心を水平に向けた筒状の炉本体と、該炉本体に着脱自在に装着され該炉本体の開口を閉鎖する蓋体と、該加熱炉の内部空間を2つに区画し、内部に窒素ガスが送り込まれる内枠体とを備え、該内枠体は、前記炉本体の軸心に沿って延びる窒素ガス用の供給管及び排出管を有し、該供給管及び排出管のうち一方の管が前記炉本体に設けられ、他方の管が前記蓋体に設けられ、前記ホルダ回転手段は、駆動源と、前記チップホルダに取着され、前記炉本体の軸心に沿って延びるホルダ軸と、該駆動源と該ホルダ軸とを連繋する連繋機構とを備え、該ホルダ軸は、前記内枠体の前記供給管及び排出管の内部に同軸上で回転自在に支持され、前記チップホルダは、複数の板材を組付けて角筒状に形成されると共に前記チップの通過を規制し得る貫通孔を有し、前記ホルダ回転手段によって、前記チップホルダを回転させて、該チップホルダ内の前記チップと、前記容器内の溶融された前記水酸化アルカリ金属とを、窒素雰囲気下で前記貫通孔を介して接触させつつ加熱して炭化物を得ることを特徴とする。

【0015】尚、上記「水酸化アルカリ金属」としては、水酸化カリウム単独、水酸化ナトリウム単独及び両者の混合物を挙げることができるが、特に、後述の実施例で示すように水酸化カリウムを用いると、チップの加熱工程を容易に行うことができ、得られる炭化物がチップホルダ等の器具に付着することを防止できると共に、得られる活性炭の比表面積をより大きくすることができるので好ましい。また、上記「不活性ガス」としては、窒素、アルゴン、ヘリウム等を挙げることができる。上記「ホルダ軸」や「チップホルダ」の材質としては、例えば、耐食性に優れた Hastelloy であることが好ましい。

【0016】

【発明の実施の形態】以下、図面を用いて本発明を実施例により具体的に説明する。尚、本実施例の炭製造装置1（図1参照）では、原料として廃タイヤを粉碎してなるチップT（図5参照）を使用する。廃タイヤについて

は炭化炉で既に炭化された炭化物とするが、炭化前の生のものであってもよい。また、粉碎方法については粉碎できる限り特に限定はなく、公知の粉碎機によって粉碎することができる。また、チップTの大きさについても、設備等の諸条件を考慮して種々の大きさとしことができ、通常は3～5 mm角程度である。さらに、タイヤ中には通常、ワイヤー等の金属が含まれているが、この金属が残存していると、後述する水酸化カリウムと加熱した際に水素ガスが大量に発生して危険であるため、公知の磁選機を用いて脱スチール処理を施したものとす

#### 【0017】1. 炭製造装置の構成

図1に示すように、炭製造装置1は、加熱炉2と、この加熱炉2内に配置されるバケット3（容器として例示する。）及びチップホルダ4と、このチップホルダ4を回転させるホルダ回転手段5とを備えて構成される。

【0018】先ず、上記加熱炉2は、一端側を開口して軸心を水平に向けた円筒状の炉本体7を備えている。この炉本体7には一端開口側に、この開口を閉鎖する円盤状の蓋体8がネジ等の固定手段によって着脱自在に装着されている。また、炉本体7の外周側には、炉本体7の円周方向及び軸心方向に所定の間隔で位相をずらして複数（4つ）の供給路9が形成されている。これら供給路9にはガスバーナ10が装着され、このガスバーナ10によって加熱炉2の内部空間に熱風を送り込むようになっている。また、炉本体7の他端側には排ガスを逃すための複数（2本）の煙突11が一体に設けられている。尚、上記複数（4つ）のガスバーナ10は、空気配管12を介して送風機13に接続されると共に、ガス配管14を介してブロパングスボンベ15に接続されている。

【0019】上記加熱炉2は、内部空間を外内2つの空間S1、S2に区画する内枠体20を備えている。この内枠体20は、支持部材21を介して炉本体7の内周径より小径となる円筒状枠部22と、この円筒状枠部22の内部空間に連なる供給管23及び排出管24とを有している。供給管23は、前記蓋体8の略中央部に一体に取付けられ、加熱炉2の外方に向かって水平に延びている。この供給管23の途中には、窒素ガスを供給するための連結管25が直交連結されている。また、排出管24は、円筒状枠部22の一端側に一体に形成され、炉本体7の他端側を突き抜けて加熱炉2外方に向かって水平に延びている。この排出管24の途中には、窒素ガスをガスホルダ（図示せず）へ逃すための連結管26が直交連結されている。尚、上記各連結管25、26は、供給管23及び排出管24に対してフランジ部27を介してネジ等の固定手段により着脱自在に取付けられている。

【0020】また、上記供給管23及び排出管24の途中には、後述するホルダ軸の支持のためのベアリング部30及び軸受部31が夫々配設されている。ベアリング部30では、図2に示すように、排出管24（供給管2

3）に溶接等により取着されたベアリングケース32内に軸受33を内蔵し、この軸受33によってホルダ軸50が回転自在に支持される。また、排出管24側のベアリング部30では、軸受33とホルダ軸50とは一体とされており、従って、ホルダ軸50は、排出管24内部を軸心に沿って水平移動自在とされている。また、上記軸受部31では、図3に示すように、供給管23（排出管24）にフランジ部35を介して板状の支持部材36が固定され、この支持部材36の半円状の切欠き部39によってホルダ軸50が支持されている。従って、ホルダ軸50のたわみが防止されるようになっている。

【0021】次に、上記バケット3は、図4、5に示すように、軸心を水平に向けた円筒状であって、外周上側を切断して上部を開放した形状に形成されている。また、バケット3内には仕切板41が固定され、この仕切板41によってバケット3の内部空間は、後述する水酸化カリウムが供給される空間と、バケット3を蓋体8に取付けるための空間とに仕切られている。そして、バケット3は、蓋体8の裏面側にネジ等の固定手段により着脱自在に固定され、後述するチップホルダ4と共に、円筒状枠部22内に位置している。

【0022】次に、上記チップホルダ4は、図4、5に示すように、丸孔状の多数の貫通孔43を全面に一樣に形成してなる複数の板材44（例えば、パンチングメタル等）を溶接等により組付けて、軸心を水平に向けた6角筒状に形成されている。このチップホルダ4の上端部を除いた大部分が上記バケット3の内部空間内に収納されている。また、チップホルダ4の外周面を構成する1つの板材44a（開閉蓋部材として例示する。）は、蝶番45及び固定具46を介して開閉自在に装着されている。従って、この板材44aを開放した際、チップホルダ4の外周面には開口部47が形成され、この開口部47を介してチップTをチップホルダ4内に投入供給し得るようになっている。また、チップホルダ4の両端面側には取付孔48が形成され、これら取付孔48を介してホルダ軸50が串刺し状に溶接等により取着されている。尚、上記貫通孔43の大きさとしては、供給されるチップTの通過（落下）を規制できる程度の大きさに設定され、通常、チップTの大きさが3～5 mmである場合には、貫通孔43の直径は2 mm程度に設定される。

【0023】次に、再び図1に戻って、上記ホルダ回転手段5について説明する。このホルダ回転手段5は、上記ホルダ軸50と駆動モータ51（駆動源として例示する。）とを連繋するギヤ機構52（連繋機構として例示する。）を備えている。上記ホルダ軸50は、上述のように、ベアリング部30及び軸受部31によって、前記円筒状枠部22、供給管23及び排出管24の内部で回転自在に支持されている。また、上記ギヤ機構52は、このホルダ軸50の一端側に固定されたギヤ53と、このギヤ53と噛合する駆動モータ51の出力軸に固定さ

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れたギヤ54とから構成される。そして、駆動モータ51の駆動力がギヤ機構52を介してホルダ軸50に伝達され、このホルダ軸50と共にチップホルダ4が所定の回転速度で回転されるようになっている。

#### 【0024】2. 炭製造装置の作用

次に、以上のように構成された炭製造装置1の作用について説明する。まず、チップホルダ4に、板材44aを開放して開口部47から所定量(約1kg)のチップTを供給し、バケット3内の空間にフレック状の所定量(約4kg)の水酸化カリウムを供給する(図5参照)。この状態で、図1に示すように、供給管23を介して円筒状枠部22内に窒素ガスを通気し、この窒素ガスを排出管24を介してガスホルダへ排気する。そして、各ガスバーナ10に対して空気及びガスを供給して加熱炉2の加熱を行う。この加熱により、加熱炉2内の空間S2、即ち円筒状枠部22内の温度は、常温から約880℃まで上昇し(所用時間50分)、その後、約880℃を100分保持することとする。また、加熱炉2内の空間S1の温度は、約900～950℃まで上昇し、さらに煙突11から800～850℃の排ガスが排気される。

【0025】上記加熱中には、駆動モータ51を作動させてホルダ軸50と共にチップホルダ4を毎分約1回転の速さで回転させる。すると、チップホルダ4内で攪拌されるチップTが、多数の貫通孔43を介して溶融された水酸化カリウムと接触しつつ、窒素雰囲気下で加熱され、高品質の活性炭が製造されることとなる。

【0026】その後、上記加熱が完了した後、炉本体7と蓋体8との固定を解除し、駆動モータ51とホルダ軸50との連繋を解除し、さらに、各連結管25、26の供給管23及び排出管24への連結を解除しておく。この状態で、炉本体7に対して蓋体8を離反方向に水平移動させると、蓋体8と一体のバケット3、供給管23及びチップホルダ4が炉本体7内から取り出され、得られた活性炭を回収することとなる。

#### 【0027】3. 実施例の効果

以上のように本実施例では、駆動モータ51を作動させてホルダ軸50と共にチップホルダ4を毎分約1回転の速さで回転させ、チップホルダ4内で攪拌されるチップTを、溶融された水酸化カリウムと接触させつつ窒素雰囲気下で加熱させるようにしたので、水酸化カリウムの腐食性によって比表面積の大きな(1000m<sup>2</sup>/g以上)活性炭を得ることができる。また、本実施例では、チップホルダ4は、複数の板材44を組付けてなる単純な六角筒状に形成されているので、チップホルダ4内のチップTを容易に攪拌することができ、チップTと水酸化カリウムとを十分に混ぜ合わせて、より高品質な活性炭を得ることができる。さらに、チップホルダ4内に炭化物が付着し難く、このチップホルダ4の清掃等のメン

テナンス作業の回数を低減させることができる。

【0028】また、本実施例では、炉本体7に対して蓋体8と共にバケット3やチップホルダ4を取り出せるようにしたので、炉本体7内部や各部品のメンテナンス作業を容易かつ迅速に行うことができる。また、チップホルダ4のみを回転させチップTを攪拌するようにしたので、従来のロータリーキルン式の炭製造装置のように比較的重量の大きな炉本体を回転させるものに比べ、装置全体として小型でかつ簡易な構造とすることができる。また、本実施例では、ホルダ軸50を一对のベアリング部30及び軸受部31によって回転自在に支持するようにしたので、ホルダ軸50のたわみ等を防止することができ、本装置を長期使用しても、チップホルダ4を正確に回転させることができる。

【0029】尚、本発明においては、前記具体的な実施例に示すものに限られず、目的、用途に応じて本発明の範囲内で種々変更した実施例とすることができる。即ち、本実施例では、チップホルダ4を六角筒状に形成したが、これに限定されず、6未満の4、5角筒状等としたり、6を超える7、8角筒状等としたりでき、さらに、円筒状に形成することができる。また、本実施例では、チップホルダ4を、その周面に丸孔状の多数の貫通孔43を設けて構成したが、これに限定されず、例えば、チップホルダをその周面に、長孔状の複数の貫通孔を並設して構成したり、渦巻き状や蛇腹状の単数あるいは複数の貫通孔を設けて構成したりできる。また、本実施例では、煙突11を介してガスバーナ10による熱風を大気中に排気するようにしたが、これに限定されず、排気ガスを加熱炉の加熱に再度利用するようにしてもよい。

#### 【0030】

【発明の効果】本発明の炭製造装置によれば、加熱炉内において、チップと水酸化アルカリ金属とを十分に混ぜ合わせることができ、比表面積の大きな活性炭を得ることができる。さらに、メンテナンス性に優れた小型で簡易な構造の炭製造装置を提供することができる。

#### 【図面の簡単な説明】

【図1】実施例に係る炭製造装置を説明するための概略図である。

【図2】図1のII矢視部の拡大断面図である。

【図3】図1のIII-III線拡大断面図である。

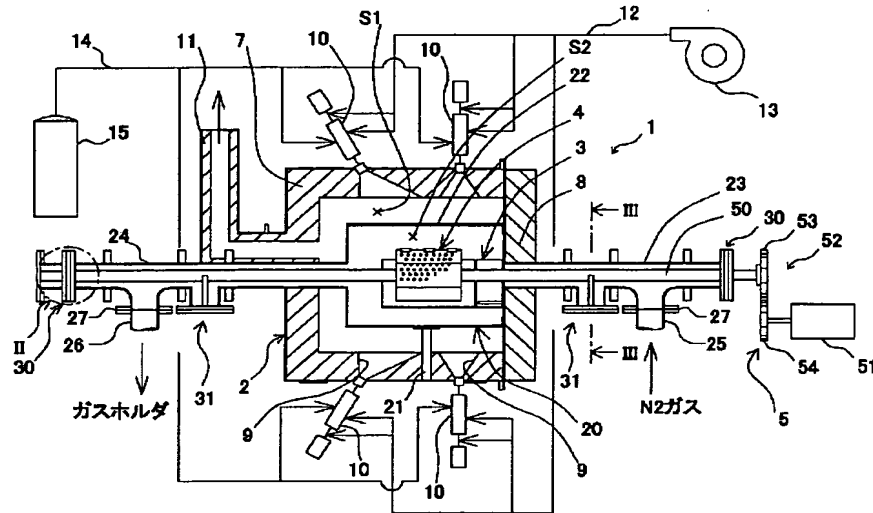
【図4】図1の要部拡大断面図である。

【図5】図4のV-V線断面図である。

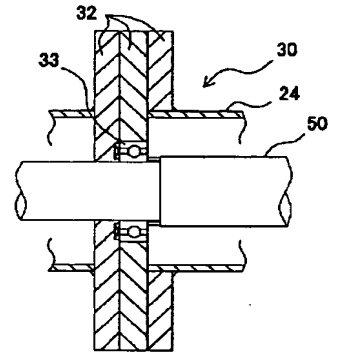
#### 【符号の説明】

1；炭製造装置、2；加熱炉、3；バケット、4；チップホルダ、5；ホルダ回転手段、7；炉本体、8；蓋体、20；内枠体、43；貫通孔、44a；板材、47；開口部、50；ホルダ軸、51；駆動モータ、52；ギヤ機構、T；チップ。

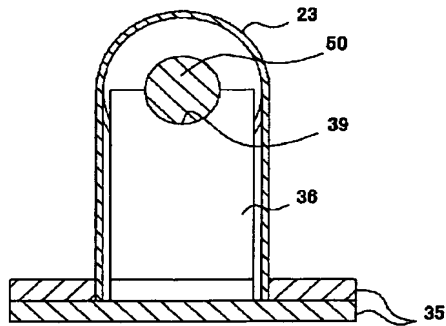
【図1】



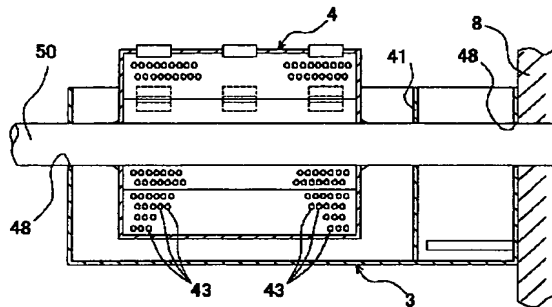
【図2】



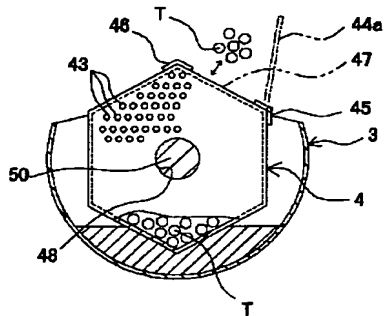
【図3】



【図4】



【図5】



フロントページの続き

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